

# LONDON- WEST MIDLANDS ENVIRONMENTAL STATEMENT

## Volume 5 | Technical Appendices

CFA16 | Ladbroke and Southam

**Water resources assessment (WR-002-016)**

Water resources

November 2013

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Department  
for Transport

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# Appendix WR-002-016

Environmental topic:	Water resources and flood risk assessment	WR
Appendix name:	Water resources assessment	002
Community forum area:	Ladbroke and Southam	016

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# 1 Introduction

## 1.1 Structure of the water resources and flood risk assessment appendices

- 1.1.1 The water resources and flood risk assessment appendices comprise three parts. The first of these is a route-wide appendix (Appendix WR-001-000).
- 1.1.2 Two specific appendices for each community forum area (CFA) are also provided. For Ladbroke and Southam (CFA16) these are:
- a Water Resources Assessment (i.e. this appendix);
  - a Flood Risk Assessment (Appendix WR-003-016); and
  - a River Modelling Report (appendix WR-004-009).
- 1.1.3 Maps referred to throughout the water resources and flood risk assessment appendices are contained in the Volume 5: Map Book – Water resources, Maps WR-01 to WR-06 and the Volume 5: Map Book – Ecology, Maps EC-01 to EC-04.

## 1.2 Study area

- 1.2.1 The study area for this CFA is located between Wormleighton and Bascote, within the county of Warwickshire. The area is predominantly rural and overlies both superficial and bedrock aquifers. Topography varies between 140m and 70m above ordnance datum (mAOD).
- 1.2.2 The spatial scope of the surface water assessment was based upon the identification of surface water and groundwater features within 1km of the centreline of the Proposed Scheme, except where there is clearly no hydraulic connectivity as outside of these distances it is unlikely that direct impacts upon the water environment will be attributable to the Proposed Scheme. Where works extend more than 200m from the centreline, for example at diversions and new/realigned roads, a professional judgement was made in selecting the appropriate limit to the extension in spatial scope required. For the purposes of this assessment this is defined as the study area.
- 1.2.3 Due to the number of ponds and other water features present within the study area, only those either within the land required for the construction or operation of the scheme, or within the calculated zone of influence (i.e. those potentially affected by the Proposed Scheme) have been detailed in the baseline.

## 2 Stakeholder engagement

2.1.1 Discussions with the following stakeholders has been undertaken to inform the water resources assessment:

- the Environment Agency on 31 September 2012 to discuss multiple aspects of the Proposed Scheme;
- the Environment Agency on 21 December 2012; and
- the Environment Agency and Warwickshire LLFA on 4 June 2013.

## 3 Baseline data

### 3.1 General

- 3.1.1 The following section provides a current description of water resources including surface water and groundwater.

### 3.2 Surface water features

- 3.2.1 All surface water features within 1km of the route are presented in Table 1.
- 3.2.2 The current surface water baseline is shown in Volume 5: Map Book – Water resources, Maps WR-01-025 to WR-01-027. Where a water feature in Table 1 has been given a map reference it appears on one of these maps.



## Appendix WR-002-016 | Baseline data

Table 1: Surface water features within 1km of the route in CFA16

Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Pond	At Fox Covert. Map WR-01-025 (H6)	Not applicable			Refer to ecology Volume 2, CFA Report 16, Section 7.	-	-	-	-
Tributary of Oxford Canal	At Hall Farm, 890m south-west of the route. Map WR-01-025 (H7)	Ordinary watercourse	Clayton and Wormleighton Brook, Source to Highfurlong Brook (GB106039037370) – Moderate Potential.	Good potential	Moderate	-	Clayton and Wormleighton Brook	-	Will not be crossed by the route
Pond / Lake	With throughflow drainage to the Oxford Canal at the Three Shires, 780m south-west of the route. Map WR-01-025 (H7)	Ordinary watercourse	Clayton and Wormleighton Brook, Source to Highfurlong Brook (GB106039037370) – Moderate Potential.	Good Potential	Moderate	-	Clayton and Wormleighton Brook	-	Will not be crossed by the route.

<sup>1</sup> Only ponds within the land required for the permanent Proposed Scheme are listed in this table.

<sup>2</sup> Map references taken from Volume 5: Map Book – Water resources, Maps WR-01-025, WR-01-026 and WR-01-027.

<sup>3</sup> For the purpose of this assessment canals have been assigned to the category of ordinary watercourse.

<sup>4</sup> Environment Agency water-feature classification: The Land Drainage Act 1991 defines an Ordinary watercourse as 'A watercourse that is not part of a main river, all rivers and streams, ditches, drains, cuts, culverts, dikes, sluices, sewers (other than public sewers) and passages through which water flows'. 'Main Rivers' are larger rivers and streams designated by DEFRA, main rivers are regulated by the Environment Agency.

<sup>5</sup> Year may vary in different RBMPs.

<sup>6</sup> The Environment Agency (2009), *River Basin Management Plan – Severn River Basin District* (p14).

<sup>7</sup> For examples of receptor value see Table 43 in the SMR addendum Volume 5 Appendix CT-001-000/2.

<sup>8</sup> Q95 flow values only provided for water features crossed by the route.

Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Tributary of Oxford Canal	At the Three Shires, 770m south-west of the route. Map WR-01-025 (H7)	Ordinary watercourse	Clayton and Wormleighton Brook, Source to Highfurlong Brook (GB106039037370) – Moderate Potential.	Good Potential	Moderate	-	Clayton and Wormleighton Brook	-	Will not be crossed by the route.
Pond / Lake / Reservoir	At Newfield Pool, 310m north-east of proposed alignment route. Map WR-01-025 (G5)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	At Newfield Pool, 425m north-east of the route. Map WR-01-025 (F5)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	At Stoneton Farm, 340m east of the route. Map WR-01-025 (F5)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	At Stoneton Manor, 515m east of the route. Map WR-01-025 (F5)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Drain feeder to Oxford Canal	Downstream of Long Spinney, 900m south-west of the route. Map WR-01-025 (F7)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.

Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Tributary of Oxford Canal	Downstream of Long Spinney, 890m south-west of the route.  Map WR-01-025 (F7)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Oxford Canal	At Stoneton Farm, will be crossed by the route.  (SWC-CFA16-001)  Map WR-01-025 (E5)	Not applicable	Oxford Canal, summit pound (GB70910196) – Good Potential.	Good Potential by 2015	Moderate	-	Oxford Canal	-	
Tributary of River Itchen	At Church Farm, 100m east of the route.  Map WR-01-025 (E5)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	East of Church Farm, 855m east of the route.  Map WR-01-025 (E4)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	South of Chapel Bank Cottage, 500m east of the route.  Map WR-01-025 (E4)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Drain	Feeder to River Itchen, 940m east of the route.  Map WR-01-025 (E4)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.

Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Tributary of River Itchen	South of Chapel Bank Cottage will be crossed by the route. (SWC-CFA16-002) Map WR-01-025 (D5)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	0.008 m <sup>3</sup> /s	River Itchen	8.633km <sup>2</sup>	
Drain	Moor Main Drain at Chapel Bank Cottage – feeder to River Itchen, 1km east of the route. Map WR-01-025 (D5)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Drain	Feeder to River Itchen at Lower Radbourne Farm, 550m west of the route. Map WR-01-025 (C6)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	At Chapel Bank Cottage, will be crossed by the route. (SWC-CFA16-003) Map WR-01-025 (B4)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	0.007 m <sup>3</sup> /s	River Itchen	7.56km <sup>2</sup>	
Drain	At Ladbroke Grove Farm, 900m east of the route. Map WR-01-025 (B3)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	--	Will not be crossed by the route.

## Appendix WR-002-016 | Baseline data

Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Drain	At Woodlands Farm, 315m west of the route. Map WR-01-025 (B5)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	At Ladbroke Fox Covert, will be crossed by the route. (SWC-CFA16-004) Map WR-01-025 (B4)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	0.002 m <sup>3</sup> /s	River Itchen	2.104km <sup>2</sup>	
Drain	Feeder to River Itchen at Bridge Lane – Ladbroke, 840m west of the route. Map WR-01-026 (F7)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Pond	West of Southam Road (A423), 15m west of the route. Map WR-01-026 (E6)	Not applicable			Refer to ecology Volume 2, CFA Report 16, Section 7	-	-		Will not be crossed by the route.
Pond	At The Oaks, – 20m west of the route. Map WR-01-026 (E6)	Not applicable			Refer to ecology Volume 2, CFA Report 16, Section 7	-	-		Will not be crossed by the route.

Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Tributary of River Itchen	At Starbold Farm, 110m west of the route. Map WR-01-026 (D6)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	At Fields Farm, 850m west of the route. Map WR-01-026 (D7)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	At Stapenhall Farm, 635m west of the route. Map WR-01-026 (C7)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Stowe	At Holywell Road, 820m east of the route. Map WR-01-026 (C5)	Ordinary watercourse	River Stowe – source to confluence River Itchen (GB109054044090) – Poor Status.	Good Status	Moderate	-	River Stowe	-	Will not be crossed by the route.
Drain	Feeder to River Itchen at Stoney Thorpe Hall, 360m east of the route. Map WR-01-026 (B5)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	Upstream of Thorpe Bridge, 195m west of the route. Map WR-01-026 (B6)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.

Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Tributary of River Itchen	Downstream of Thorpe Bridge, 330m east of the route. Map WR-01-026 (B5)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Drain	Feeder to River Itchen downstream of Thorpe Bridge, 310m east of the route. Map WR-01-026 (F7)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
River Itchen	At Thorpe Bridge, will be crossed by the route. (SWC-CFA16-005) Map WR-01-026 (B6)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	0.061 m <sup>3</sup> /s	River Itchen	78km <sup>2</sup>	
River Stowe	At Browns Bridge, 675m east of the route. Map WR-01-026 (C5)	Main river	River Stowe – source to confluence River Itchen (GB109054044090) – Poor Status.	Good Status	High	-	River Stowe	-	Will not be crossed by the route.
River Itchen	At Stoney Thorpe Hall, 675m east of the route. Map WR-01-026 (B5)	Ordinary watercourse	River Itchen – confluence River Stowe to confluence River Leam (GB109054044110) – Poor Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary of River Itchen	At Lower Farm, 100m west of the route. Map WR-01-026 (B6)	Ordinary watercourse	River Itchen – source to confluence with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.

Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Drain	Feeder to River Itchen at Stoney Thorpe Hall, 700m east of the route.  Map WR-01-026 (B5)	Ordinary watercourse	River Itchen – confluence River Stowe to confluence River Leam (GB109054044110) – Poor Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Drain	Feeder to River Itchen at Stoney Thorpe Mill, 730m east of the route.  Map WR-01-026 (B5)	Ordinary watercourse	River Itchen – confluence River Stowe to confluence River Leam (GB109054044110) – Poor Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Pond / Lake / Reservoir	Lake/Reservoir with throughflow drainage to River Itchen at Lower Farm, 195m west of the route.  Map WR-01-026 (B6)	Ordinary watercourse	River Itchen – source to conf with River Stowe (GB109054044070) – Moderate status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Mill Pond backwater of River Itchen	At Stoney Thorpe Mill, 715m east of route.  Map WR-01-026 (B5)	Ordinary watercourse	River Itchen – confluence River Stowe to confluence River Leam (GB109054044110) – Poor Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Pond / Lake / Reservoir	Lake/Reservoir with throughflow drainage to River Itchen at Monkey Barn Farm, 810m west of the route.  Map WR-01-027 (G7)	Ordinary watercourse	River Itchen – source to conf with River Stowe (GB109054044070) – Moderate Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.



Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Tributary of River Itchen	At Thorpe Rough (Fox Covert), 265m east of the route. Map WR-01-027 (G5)	Ordinary watercourse	River Itchen – confluence River Stowe to confluence River Leam (GB109054044110) – Poor Status.	Good Status	Moderate	-	River Itchen	-	Will not be crossed by the route.
Tributary to Grand Union Canal	At Welsh Road, 635m east of the route. Map WR-01-027 (F4)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	Grand Union Canal	-	Will not be crossed by the route.
Tributary to Grand Union Canal	At Ufton Wood (Fox Covert), 800m west of the route. Map WR-01-027 (E7)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	Grand Union Canal	-	Will not be crossed by the route.
Drain	Feeder to Grand Union Canal at Splash Bridge, 370m east of the route. Map WR-01-027 (E4)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	Grand Union Canal	-	Will not be crossed by the route.
Feeder stream to Grand Union Canal	At Welsh Road Bridge, 300m east of the route. Map WR-01-027 (E5)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	Grand Union Canal	-	Will not be crossed by the route.
Drain	From Lower Print Farm – north of Grand Union Canal, 370m east of the route. Map WR-01-027 (E5)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	Grand Union Canal	-	Will not be crossed by the route.

Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Tributary to Grand Union Canal	At Welsh Road Bridge, 370m east of the route.  Map WR-01-027 (E5)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	Grand Union Canal	-	Will not be crossed by the route.
Tributary of River Leam	At Longhole Bridge, will be crossed by the route.  (SWC-CFA16-006)  Map WR-01-027 (F7)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	River Leam	-	
Drain	Feeder to Grand Union Canal at Longhole Bridge, 100m west of the route.  Map WR-01-027 (E6)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	Grand Union Canal	-	Will not be crossed by the route.
Tributary of River Leam	At Longhole Bridge, 100m west of the route.  Map WR-01-027 (E6)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	River Leam	-	Will not be crossed by the route.
Drain	Feeder to Grand Union Canal.  Map WR-01-027 (D6)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	Grand Union Canal	-	Will not be crossed by the route – Feeder drain to Grand Union Canal.

## Appendix WR-002-016 | Baseline data

Water feature <sup>1</sup>	Location description (map reference) <sup>2</sup>	Watercourse classification <sup>3,4</sup>	Water Framework Directive (WFD) water body name and identifier and overall status	WFD status objective (by 2027 <sup>5</sup> as per River Basin Management Plan (RBMP <sup>6</sup> ) unless stated)	Receptor value <sup>7</sup>	Q95 <sup>8</sup>	Catchment/s	Size	Notes
Grand Union Canal	At Longhole Bridge, 10m west of the route.  Map WR-01-027 (E5)	Ordinary watercourse	Grand Union Canal, Braunston to Leamington Spa (GB70910511) – Good Potential.	Good Potential by 2015	Moderate	-	Grand Union Canal	-	Will not be crossed by the route.

- 3.2.3 Table 2 summarises licensed surface water abstractions within 1km of the route. Surface water abstracted for public supply is not known for reasons of national security. Information from Stratford-on-Avon District Council indicates that there are no unlicensed abstractions from surface water used for potable supply in their records.

Table 2: Licensed surface water abstractions

Licence identifier map reference number <sup>9</sup> and Environment Agency reference	Distance from route	Abstraction source	Maximum annual abstraction quantity	Maximum daily abstraction quantity	Purpose
18/54/12/0151	740m north-east of the route.	Stoneythorpe Mill, Hall and Polo Centre, Southam – River Itchen.	89,996m <sup>3</sup>	596m <sup>3</sup>	Spray irrigation – storage

- 3.2.4 Table 3 summarises surface water discharge permits within 1km of the route.

Table 3: Permitted discharges to surface water

Reference number and map reference <sup>10</sup>	Permit identifier	Distance from route	Discharge type	Receiving water body
80511646 Map WR-01-025 (F7)	S/12/25850/R	650m south-west of the route	Sewage discharge	Tributary of River Itchen
27246141 Map WR-01-025 (F7)	S/12/25850/R	650m south-west of the route	Sewage discharge	Tributary of River Itchen
8900266 Map WR-01-026 (E6)	S/12/25632/S	230m south-west of the route	Sewage discharge	Ditch / Tributary of River Itchen
1486125 Map WR-01-026 (D5)	A.265/1	585m north-east of the route	Surface water discharge	River Stowe
19448892 Map WR-01-026 (C4)	S/12/25045/O	900m north-east of the route	Sewage discharge	River Stowe
1486162 Map WR-01-026 (C4)	S/12/25045/O	900m north-east of the route	Sewage discharge	River Stowe
1486164 Map WR-01-026 (C4)	S/12/25045/O	910m north-east of the route	Sewage discharge	River Stowe
19448893 Map WR-01-026 (C4)	S/12/25045/O	910m north-east of the route	Sewage discharge	River Stowe
1486114 Map WR-01-026 (B6)	S/12/10109/S	105m north-east of the route	Sewage discharge	Tributary of River Itchen
8898717 Map WR-01-026 (B5)	S/12/25596/S	760m north-east of the route	Sewage discharge	River Itchen
8898569 Map WR-01-026 (B6)	S/12/25599/S	150m south-west of the route	Sewage discharge	Tributary of River Itchen
1477179 Map WR-01-026 (B6)	S/12/20438/S	185m south-west of the route	Sewage discharge	Tributary of River Itchen

<sup>9</sup> Map references taken from Volume 5: Map Book – Water resources, Maps WR-01-025, WR-01-026 and WR-01-027.

<sup>10</sup> Map references taken from Volume 5: Map Book – Water resources, Maps WR-01-025, WR-01-026 and WR-01-027.

Reference number and map reference <sup>10</sup>	Permit identifier	Distance from route	Discharge type	Receiving water body
1486098 Map WR-01-027 (G4)	S/12/22996/S	950m north-east of the route	Sewage discharge	Tributary of River Itchen
64454422 Map WR-01-027 (G5)	Npswqd005650	990m south-west of the route	Waste site discharge	Unnamed tributary of River Itchen
1477177 Map WR-01-027 (G7)	S/12/05719/S	275m north-east of the route	Sewage discharge	River Itchen
8900377 Map WR-01-027 (E6)	S/12/25450/S	160m south-west of the route	Sewage discharge	Tributary of River Leam
90726460 Map WR-01-027 (C4)	Eprap3823ke	860m north-east of the route	Sewage discharge	Tributary of River Itchen

### 3.3 Groundwater

- 3.3.1 Groundwater within CFA16 lies primarily within the Warwickshire Avon – Secondary Mudrocks Groundwater Body (GB40902G990900) which is currently classified as being of good chemical and quantitative quality and is predicted to remain as being of good chemical and quantitative quality by 2015 under the WFD. The southernmost portion of the study area, from around Fox Covert southwards lies within the Banbury Jurassic Groundwater Body (GB40602G600200) which is also currently designated as being of good chemical and quantitative quality and is predicted to be of good chemical and quantitative quality by 2015 under the WFD.
- 3.3.2 Two superficial aquifers are located within the area. These are alluvium which is designated as a Secondary A aquifer and head which is classified as a Secondary Undifferentiated aquifer. These aquifers are of moderate value.
- 3.3.3 Several underlying bedrock aquifers are located within the study area. These are:
- interbedded mudstone and limestone of the Rugby Limestone Member (Blue Lias Formation) and the siltstone and sandstone of the Arden Sandstone Formation (Mercia Mudstone Group) which are classified as Secondary A aquifers of moderate value;
  - mudstone of the Saltford Shale Member (Blue Lias Formation), the interbedded argillaceous rock and subequal / subordinate limestone of the Penarth Group and the mudstone of the Mercia Mudstone Group which are classified as Secondary B aquifers of moderate value;
  - limestone of the Charmouth Mudstone Formation, the limestone of the Langport Member (Penarth Group) and the dolomitic siltstone of the Mercia Mudstone Group are classified as Secondary undifferentiated aquifers of moderate value; and
  - mudstone of the Charmouth Mudstone Formation, classified as Unproductive strata of low value.
- 3.3.4 There are no source protection zones (SPZs) within the area.

3.3.5 Table 4 summarises licensed groundwater abstractions, as well as unlicensed potable supplies notified to HS2 Ltd by Stratford on Avon District Council, within the study area.

Table 4: Groundwater abstractions

Licence identifier (map reference number <sup>11</sup> and Environment Agency reference)	Distance from route	Abstraction horizon	Maximum annual abstraction quantity	Maximum daily abstraction quantity	Number of boreholes	Purpose
CFA16-GWUA1  Spring at Stoneton Moat Farm, in Stoneton.  Map WR-02-016 (H6) Stoneton, 2.8km south-east of Lower Radbourne South viaduct.	830m north-east of the route	Likely to be from the mudstone of the Charmouth Mudstone Group.	Not Provided, less than 20m <sup>3</sup>	Not Provided, less than 20m <sup>3</sup>	1	Private water supply.
MD/054/0012/002  Oaktree House, Bascote Heath.  Map WR-02-016 (C6) Bascote Heath, 1km south-west of Bascote.	480m north-east of the route	Likely to be from the Langport Member Limestone.	5,142m <sup>3</sup>	46m <sup>3</sup>	1	Water supply for heat pump.
CFA16-GWUA2  Borehole at Wood Farm.  Map WR-02-016 (B6), 1km north-east of Ufton.	280m south-west of the route	Likely to be from the mudstone of the Mercia Mudstone Group.	Not Provided, less than 20m <sup>3</sup> .	Not Provided, less than 20m <sup>3</sup> .	1	Private water supply.
CFA16-GWUA3  Borehole at Round Brill, near Ridgeway Lane and Snowford Lodge.  Map WR-02-016 (A5), 2km east of Offchurch.	1,200m north-east of the route	Likely to be from the mudstone of the Mercia Mudstone Group.	Not Provided, less than 20m <sup>3</sup> .	Not Provided, less than 20m <sup>3</sup> .	1	Private water supply.
CFA16-GWUA4  Borehole at Snowford House, near Ridgeway Lane.  Map WR-02-016 (A5), 2km east of Offchurch.	1,100m north-east of the route	Likely to be from the mudstone of the Mercia Mudstone Group.	Not Provided, less than 20m <sup>3</sup> .	Not Provided, less than 20m <sup>3</sup> .	1	Private water supply.

3.3.6 Table 5 summarises environmental permits for groundwater discharges within the study area.

<sup>11</sup> Map references taken from Volume 5: Map Book – Water resources, Map WR-02-016.

Table 5: Groundwater discharge environmental permits

Reference number and map reference <sup>12</sup>	Permit identifier	Distance from route	Discharge type	Receiving water body
WQ/72/1513/1  Bungalow at Ladbroke Park, in Ladbroke.  Map WR-05-016 (E7) 3km north-west of Lower Radbourne North viaduct.	1485515	1,300m south-west of the route	Sewage effluent	Groundwater Warwickshire Avon – Secondary Mudrocks Groundwater Body (GB40902G990900).

## Groundwater/surface water interaction

3.3.7 Table 6 summarises springs, sinks and issues (locations where groundwater rises to the surface in a more diffuse way than at a spring) within the study area. Due to the number of ponds and other water features present within the study area, only those either within the land required for the construction or operation of the Proposed Scheme, or within the calculated zone of influence have been included in the assessment.

Table 6 : Groundwater/surface water interaction

Location description and map reference <sup>13</sup>	Distance from route	Formation	Elevation	Comments
Issues 260m north-east of The Hall Farm  Map WR-02-016 (I7), 1km south-east of Wormleighton	720m south-west of the route	Mudstone of the Charmouth Mudstone Formation	135mAOD	May receive groundwater from permeable lenses or weathered zone within the Unproductive strata.
Pond near Fox Covert and Sheep Pens  Map EC-04-040b (G7), 1km east of Wormleighton	60m south-west of the route	Mudstone of the Charmouth Mudstone Formation	140mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Pond near Fox Covert and Sheep Pens  Map EC-04-040b (G6), 1km east of Wormleighton	25m north-east of the route	Mudstone of the Charmouth Mudstone Formation	140mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Pond near Fox Covert and Sheep Pens  Map EC-04-040b (G7), 1km east of Wormleighton	50m south-west of the route	Mudstone of the Charmouth Mudstone Formation	140mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.

<sup>12</sup> Map references taken from Volume 5: Map Book – Water resources, Map WR-02-016.

<sup>13</sup> Map references taken from Volume 5: Map Book – Water resources, Map WR-02-016 and Volume 5: Map Book – Ecology, Maps EC-01 to EC-04.

Location description and map reference <sup>13</sup>	Distance from route	Formation	Elevation	Comments
Spring at southern edge of Berryhill Plantation  Map WR-02-016 (I6), 1.3km east of Wormleighton	300m north-east of the route	Mudstone of the Charmouth Mudstone Formation	145mAOD	May receive groundwater from permeable lenses or weathered zone within the Unproductive strata.
Spring at north-east edge of Berryhill Plantation  Map WR-02-016 (I6), 1.4km east of Wormleighton	550m north-east of the route	Mudstone of the Charmouth Mudstone Formation	160mAOD	May receive groundwater from permeable lenses or weathered zone within the Unproductive strata.
Spring 70m north of Berryhill Plantation  Map WR-02-016 (I5), 1.5km east of Wormleighton	650m north-east of the route	Mudstone of the Charmouth Mudstone Formation	155mAOD	May receive groundwater from permeable lenses or weathered zone within the Unproductive strata.
Spring south-west of Berryhill Farm  Map WR-02-016 (H5), 1.7km north-east of Wormleighton	1,050m north-east of the route	Mudstone of the Charmouth Mudstone Formation	165mAOD	May receive groundwater from permeable lenses or weathered zone within the Unproductive strata.
Spring south-west of Berryhill Farm  Map WR-02-016 (H5), 1.7km north-east of Wormleighton	975m north-east of the route	Mudstone of the Charmouth Mudstone Formation	145mAOD	May receive groundwater from permeable lenses or weathered zone within the Unproductive strata.
Spring south-east of Newfield Pool  Map WR-02-016 (H6), 1.2km north-east of Wormleighton	500m north-east of the route	Mudstone of the Charmouth Mudstone Formation	135mAOD	May receive groundwater from permeable lenses or weathered zone within the Unproductive strata.
Issues near Stoneton Manor and moat  Map WR-02-016 (H5), 1.5km north-east of Wormleighton	800m north-east of the route	Mudstone of the Charmouth Mudstone Formation	135mAOD	May receive groundwater from permeable lenses or weathered zone within the Unproductive strata.
Pond near Wormleighton  Map EC-04-040b (D7), 500m north-east of Wormleighton	200m south-west of the route	Mudstone of the Charmouth Mudstone Formation	145mAOD	Located on Unproductive strata and on elevated topography therefore unlikely to be groundwater dependent.
Oxford Canal  Map EC-01-041 (I6 and I7), will be crossed by Oxford Canal viaduct	Will be crossed by the route	Also a water dependent habitat. Refer to Table 7 for further information.		



Location description and map reference <sup>13</sup>	Distance from route	Formation	Elevation	Comments
Issues south-east of Church Farm  Map WR-02-016 (G6), 1.6km north of Wormleighton	100m north-east of the route	Mudstone of the Charmouth Mudstone Formation	110mAOD	May receive groundwater from permeable lenses or weathered zone within the Unproductive strata.
Stream 650m south-east of Lower Radbourne Farm  Map WR-02-016 (G6), will be crossed by Lower Radbourne South viaduct	Will be crossed by the route	Mudstone of the Charmouth Mudstone Formation	Not applicable	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Pond 500m south-east of Lower Radbourne Farm  Map EC-04-041 (E7), 150m south-west of Lower Radbourne North viaduct	90m west of the route	Mudstone of the Charmouth Mudstone Formation	100mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata.
Lower Radbourne Church Pools  Map EC-01-041 (E4 to E7) will be crossed by Lower Radbourne South viaduct at EC-01-041 (E6)	Will be crossed by the route	Also a water dependent habitat. Refer to Table 7 for further information.		
Issues north-east of Lower Radbourne Farm  Map WR-02-016 (F6), 750m west of Lower Radbourne North viaduct	700m south-west of the route	Mudstone of the Charmouth Mudstone Formation overlain by alluvium	90mAOD	May receive groundwater from the Secondary A aquifer in addition to groundwater from permeable lenses of weathered zone within the underlying Unproductive strata.
Pond 770m south-west of Upper Radbourne Farm  Map EC-04-041 (C6), 650m north of Lower Radbourne North viaduct	50m north-east of the route	Mudstone of the Charmouth Mudstone Formation	110mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Pond 620m north of Lower Radbourne Farm  Map EC-04-041 (C7), 800m north-west of Lower Radbourne North viaduct	200m south-west of the route	Mudstone of the Charmouth Mudstone Formation	110mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Pond 750m north of Lower Radbourne Farm  Map EC-04-041 (B7), 960m north-west of Lower Radbourne North viaduct	300m south-west of the route	Mudstone of the Charmouth Mudstone Formation	115mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.

Location description and map reference <sup>13</sup>	Distance from route	Formation	Elevation	Comments
Pond near Ladbroke Grove Farm  Map EC-04-042 (I6), 1.35km north-west of Lower Radbourne North viaduct	110m north-east of the route	Mudstone of the Charmouth Mudstone Formation	105mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Tributary of River Itchen, north of Ladbroke Fox Covert  Map WR-02-016 (F5), will be crossed by route 1km east of Ladbroke	Will be crossed by the route	Mudstone of the Charmouth Mudstone Formation overlain by alluvium	Not applicable	May receive groundwater from Secondary A Superficial deposits overlying Unproductive strata.
Issues 400m north of Ladbroke Grove Farm  Map WR-02-016 (F5), 1.6km east of Ladbroke	600m north-east of the route	Mudstone of the Charmouth Mudstone Formation overlain by alluvium	105mAOD	May receive groundwater from the Secondary A superficial deposits in addition to groundwater from permeable lenses within the underlying Unproductive strata.
Pond adjacent to Windmill Lane and track from Ladbroke Hill Farm  Map EC-04-042 (G6), 750m east of Ladbroke	25m south-west of the route	Mudstone of the Charmouth Mudstone Formation	105mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Issues near Ladbroke Hall and Church Road in Ladbroke  Map WR-02-016 (E6), in Ladbroke	1,100m south-west of the route	Mudstone of the Charmouth Mudstone Formation overlain by alluvium	90mAOD	May receive groundwater from the Secondary A superficial deposits in addition to groundwater from permeable lenses within the underlying Unproductive strata.
Pond near Windmill Lane  Identifier: 030-AA-122002  Map EC-04-042 (F7), 325m north-west of Windmill Lane Green Overbridge	200m south-west of the route	Mudstone of the Charmouth Mudstone Formation	105mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Pond 350m north of Windmill Hill Spinney  Identifier: 030-AA-123002  Map EC-04-042 (E6), 700m north-east of Ladbroke	60m north-east of the route	Mudstone of the Charmouth Mudstone Formation	90mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Tributary of River Itchen, crosses A423 near Starbold Farm  Map WR-02-016 (E6), 580m north of Ladbroke	190m south-west of the route	Mudstone of the Charmouth Mudstone Formation	Not applicable	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.

Location description and map reference <sup>13</sup>	Distance from route	Formation	Elevation	Comments
Pond 500m south-east of Starbold Farm  Identifier: 030-AA-123001  Map EC-04-042 (D6), 750m north of Ladbroke	10m south-west of the route	Mudstone of the Charmouth Mudstone Formation	90mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Pond near Harp Farm  Identifier: 030-AA-124002  Map EC-04-042 (C6), 800m north of Ladbroke	128m north-east of the route	Mudstone of the Charmouth Mudstone Formation	86mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Two Ponds near Harp Farm  Map EC-04-042 (C6), 800m north of Ladbroke	10m south-west of the route	Mudstone of the Charmouth Mudstone Formation	90mAOD	Unlikely to be groundwater dependent as lies on Unproductive strata. Likely to be surface water and rainfall dependent.
Tributary of River Itchen, 340m north-west of Starbold Farm  Map WR-02-016 (D6), 1.4km north of Ladbroke	100m south-west of the route	Mudstone of the Charmouth Mudstone Formation and Interbedded mudstone and limestone of the Rugby Limestone Member	Not applicable	May receive groundwater from Secondary A bedrock aquifer and Unproductive strata. Likely to be surface water and rainfall dependent.
Pond near Southam  Map EC-04-043 (H6), 400m south-west of Southam	72m north-east of the route	Interbedded mudstone and limestone of the Rugby Limestone Member	82mAOD	Potentially groundwater dependent as located at low topography on permeable bedrock.
Pond at Southam Rugby Football Club  Map EC-04-043 (H7), 300m south-west of B4451 Kineton Road overbridge	265m south-west of the route	Interbedded mudstone and limestone of the Rugby Limestone Member	84mAOD	Potentially groundwater dependent as located at low topography on permeable bedrock.
Pond at southern edge of Southam Industrial Estate, adjacent to B4451 Kineton Road  Map EC-04-043 (H6), Near B4451 adjacent to B4451 Kineton Road overbridge	50m north-east of the route	Interbedded mudstone and limestone of the Rugby Limestone Member	87mAOD	Potentially groundwater dependent as located at low topography on permeable bedrock.
Issues 300m north-west of Fields Farm  Map WR-02-016 (D6), 1.8km north-west of Ladbroke	750m south-west of the route	Saltford Shale Member overlain by alluvium	78mAOD	May receive groundwater from Secondary B aquifer overlain by Secondary A aquifer.

Location description and map reference <sup>13</sup>	Distance from route	Formation	Elevation	Comments
Issues near Stapenhall Farm  Map WR-02-016 (D7), 950m north of Deppers Bridge	1,100m south-west of the route	Saltford Shale Member	80mAOD	May receive groundwater from Secondary B aquifer.
Issues 400m north of Stapenhall Farm  Map WR-02-016 (D7), 1.3km north of Deppers Bridge	1,100m south-west of the route	Saltford Shale Member	95mAOD	May receive groundwater from Secondary B aquifer.
Sinks 600m north of Stapenhall Farm  Map WR-02-016 (D7), 815m south-west of River Itchen viaduct	800m south-west of the route	Limestone of the Langport Member	90mAOD	Likely to be a culvert therefore not groundwater dependent.
Sinks 300m south of Lower Farm  Map WR-02-016 (D6), 235m south-west of River Itchen Viaduct	450m south-west of the route	Interbedded argillaceous rock and subequal / subordinate limestone of the Penarth Group	75mAOD	Likely to be a culvert therefore not groundwater dependent.
River Itchen  Map EC-01-043 (E7) will be crossed by River Itchen viaduct	Will be crossed by the route	Also a water dependent habitat. Refer to Table 7 for further information.		
Issues east of Ufton Farm Landfill  Map WR-02-016 (C6), 1.6km north of Deppers Bridge	720m south-west of the route	Limestone of the Langport Member	90mAOD	May receive groundwater from Secondary (undifferentiated) aquifer.
Spring 100m south of Stoneythorpe Hall  Map WR-02-016 (C6), 500m north-east of River Itchen viaduct	500m north-east of the route	Interbedded argillaceous rock and subequal / subordinate limestone of the Penarth Group overlain by alluvium	80mAOD	May receive groundwater from Secondary B aquifer overlain by Secondary A aquifer.
Sinks at western edge of Ufton Farm Landfill  Map WR-02-016 (C7), 1.4km west of River Itchen viaduct	1,200m south-west of the route	Limestone of the Langport Member	95mAOD	Likely to be a culvert therefore not groundwater dependent.
Issues 180m north of Monkey Barn Farm  Map WR-02-016 (C7), 1.2km west of River Itchen viaduct	800m south-west of the route	Interbedded argillaceous rock and subequal / subordinate limestone of the Penarth Group	95mAOD	May receive groundwater from Secondary B aquifer.

Location description and map reference <sup>13</sup>	Distance from route	Formation	Elevation	Comments
Issues along Ufton Hill Farm track, west of landfill  Map WR-02-016 (C7), 1.5km west of River Itchen viaduct	1,200m south-west of the route	Limestone of the Langport Member	95mAOD	May receive groundwater from Secondary (undifferentiated) aquifer.
Pond  Identifier: 030-AA-127001  Map EC-04-043 (C6 and C7), 400m south of Bascote Heath	20m north-east of the route	Interbedded argillaceous rock and subequal / subordinate limestone of the Penarth Group	95mAOD	Potentially groundwater dependent as located at low topography on permeable bedrock.
Issues 130m south of Heath Farm  Map WR-02-016 (C6), 300m south of Bascote Heath	250m north-east of the route	Interbedded argillaceous rock and subequal / subordinate limestone of the Penarth Group	90mAOD	May receive groundwater from Secondary B aquifer.
Sinks 130m south-east of Long Itchington Wood, near War Memorial  Map WR-02-016 (C6), 1.1km north-east of River Itchen viaduct	20m south-west of the route	Limestone of the Langport Member	100	Likely to be a culvert therefore not groundwater dependent.
Issues at western edge of Long Itchington Wood  Map WR-02-016 (C7), 360m north-east of Ufton	800m south-west of the route	Mudstone of the Mercia Mudstone Group	90mAOD	May receive groundwater from Secondary B aquifer.
Issues at Welsh Road, 350m northwest of Crossroads Cottage  Map WR-02-016 (C6), 440m north of Bascote Heath	625m north-east of the route	Mudstone of the Mercia Mudstone Group	80mAOD	May receive groundwater from Secondary B aquifer.
Pond near Grand Union Canal  Map EC-04-044a (E6), 200m south-east of Longhole viaduct	160m north-east of the route	Mercia Mudstone Group overlain by alluvium	65mAOD	Potentially groundwater dependent as located at low topography on permeable bedrock.
Drain (stemming from Issues)  Map WR-02-016 (B6) near Longhole viaduct	Will be crossed by the route	Mudstone of the Mercia Mudstone Group overlain by alluvium	Not applicable	May receive groundwater from Secondary B aquifer overlain by Secondary A aquifer.

Location description and map reference <sup>13</sup>	Distance from route	Formation	Elevation	Comments
Pond near Grand Union Canal  Map EC-04-044a (E7), 60m west of Longhole viaduct	60m south-west of the route	Mercia Mudstone Group overlain by alluvium	65mAOD	Potentially groundwater dependent as located at low topography on permeable bedrock.
Issues  Map WR-02-016 (B6) near Longhole viaduct	170m south-west of the route	Mercia Mudstone Group overlain by alluvium	70mAOD	May receive groundwater from Secondary B aquifer overlain by Secondary A aquifer.
Issues near Print Farm  Map WR-02-016 (B5) 640m north-east of Longhole viaduct	670m north-east of the route	Mercia Mudstone Group overlain by alluvium	70mAOD	May receive groundwater from Secondary B aquifer overlain by Secondary A aquifer.

## Water dependent habitats

3.3.8 Table 7 summarises the potential water dependent habitats within the study area. These have been identified from a review of Ordnance Survey (OS) mapping, aerial photography and from the following sources:

- information on designated and potential non-statutory Local Wildlife Sites (LWS) from Warwickshire Biological Records Centre;
- information on statutory designated sites from Natural England; and
- information from ecological surveys carried out in support of the Environmental Impact Assessment (EIA).

3.3.9 The table identifies where a water dependency may exist but the assessment of impact on water dependent ecology receptors is found in Volume 2, CFA Report 16, Section 7.

Table 7: Description of water dependent habitats

Location and map reference <sup>14</sup>	Distance	Designation	Comments
Oxford Canal  GB70910196 in Wormleighton  Map EC-01-041 (I6 and I7), will be crossed by Oxford Canal viaduct	Will be crossed by the route	Identified as wet habitat of concern	Unlikely to be dependent upon groundwater as this is an artificial watercourse on Unproductive strata. Likely to be dependent on surface water.
Lower Radbourne Church Pools  Includes section of River Itchen GB109054044070. 2.6km south-east of Ladbroke.  Map EC-01-041 (E4 to E7) will be crossed by Lower Radbourne South viaduct at EC-01-041 (E6)	Will be crossed by the route	Identified as wet habitat of concern	Potentially surface water and partially groundwater dependent as the receptor is partially underlain by superficial deposits and marshy land.

<sup>14</sup> Map references taken from Volume 5: Map Book – Ecology, Maps EC-01-040b to EC-01-044a.

Location and map reference <sup>14</sup>	Distance	Designation	Comments
<p>Southam Meadow South</p> <p>Adjacent to Banbury House and Warwick Industrial Park at southern edge of Southam</p> <p>Map EC-01-043 (I3 and I4) 1.5km south-east of River Itchen viaduct</p>	450m north-east of the route	LWS	Potentially groundwater dependent as located on permeable bedrock within a valley.
<p>River Itchen, Breakneck Fields</p> <p>800m west of Southam</p> <p>Map EC-01-043 (E7) will be crossed by River Itchen viaduct</p>	Will be crossed by the route	Identified as wet habitat of concern	Potentially groundwater and surface water dependent as watercourse lies on permeable superficial and bedrock deposits.
<p>Unnamed ancient woodland</p> <p>Adjacent to where Welsh Road crosses the River Itchen at Old Ford Bridge, 800m west of Southam</p> <p>Map EC-01-043(C3) 1km north-east of River Itchen viaduct</p>	850m north-east of the route	Ancient woodland	Unlikely to be groundwater dependent as no groundwater features nearby. Potentially surface water dependent as adjacent to two watercourses.
<p>Thorpe Rough</p> <p>North of Dallas Burston Polo Grounds, near Welsh Road, 900m west of Southam</p> <p>Map EC-01-043 (C3, C4 and C5) 880m north-east of River Itchen viaduct</p>	350m north-east of the route	Ancient woodland	Unlikely to be groundwater dependent as no groundwater features nearby. Potentially surface water dependent as adjacent to a watercourse.
<p>Ufton Fields Nature Reserve</p> <p>Adjacent to B4452, near Upton</p> <p>Map EC-01-044a (I10 and J10); WR-03-027 (G7, G8, F7 and F8). 1.7km west of River Itchen viaduct</p>	950m south-west of the route	SSSI and LNR	Potentially groundwater dependent as lies on permeable bedrock. Wetland with marshes, pools and calcareous ground at the receptor.
<p>Long Itchingdon Wood (Ufton Wood)</p> <p>Near Featherbed Lane, Bascote Heath, 2.5km north-west of Southam</p> <p>Map EC-01-44a (H6) 870m south-east of Longhole viaduct</p>	Will be crossed by the route	SSSI, Ancient woodland	Unlikely to be groundwater dependent as located on elevated topography with poorly draining soils. Perimeters of the receptor are at lower topography with springs and issues recorded.
<p>Print Wood</p> <p>North of Print Farm, near Ridgeway Lane, 2km south-east of Offchurch</p> <p>Map EC-01-44a (C3) 940m north-east of Longhole viaduct</p>	850m north-east of the route	LWS and partial Ancient woodland	Potentially groundwater dependent as lies on permeable bedrock with calcareous ground.

## 4 Site-specific assessments

### 4.1 Surface water

- 4.1.1 The following table summarises the potential impacts and effects to surface water. Table 8 summarises the potential impacts and effects to surface water.



Table 8: Summary of potential impacts to surface water

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Oxford Canal  (watercourse does not intersect route)  Map WR-01-025 (F6)	Moderate	Embankment	Moderate adverse	Deterioration of water quality due to:  Deposition of soils, sediment and other construction materials, and spillage of fuels and other hazardous liquids;  The mobilisation of contaminants following disturbance of contaminated ground or groundwater.  Uncontrolled site run-off.	Adoption of Environment Agency Pollution Prevention Guidelines (PPGs) – particularly PPG5 for in-channel works.  Mitigation measures outlined in draft CoCP.  Water management implemented during earthworks operation.  Temporary site drainage designed to retain surface run-off within site boundary.  Grey water systems used at construction site compounds.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Temporary)

<sup>15</sup> Map references taken from Volume 5: Map Book – Water resources, Maps WR-01-025, WR-01-026 and WR-01-027.<sup>16</sup> For examples of receptor value see Table 43 in the SMR addendum Volume 5 Appendix CT-001-000/2.

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Oxford Canal at Stoneton Farm  (SWC-CFA16-001)  Map WR-01-025 (E5)	Moderate	Oxford Canal viaduct ;  Embankment;  Drainage outfall;  Balancing pond.	Moderate adverse	Deterioration of water quality due to:  Deposition of soils, sediment and other construction materials, and spillage of fuels and other hazardous liquids;  The mobilisation of contaminants following disturbance of contaminated ground or groundwater.  Uncontrolled site run-off.	Adoption of Environment Agency PPGs – particularly PPG5 for in-channel works.  Mitigation measures outlined in draft CoCP.  Water management implemented during earthworks operation.  Temporary site drainage designed to retain surface run-off within site boundary.  Grey water systems used at construction site compounds.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Temporary)

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		Drainage outfall (from railway)	Moderate adverse	Impact on flows in the receiving watercourse.  Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.	Drainage has been designed to reduce the rate and volume of run-off from the proposed railway and to provide temporary storage for potential spillages.  Balancing pond before outfall to watercourse to restrict run-off rates and reduce the effect on water quality by reducing potential contaminants through filtration, vegetative absorption or settlement.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Permanent)
		All elements (maintenance)	Moderate adverse	Deterioration of water quality due to contamination from de-icing substances used during cold weather and herbicides for managing vegetation on the tracks.	Best practice pollution control guidance will be adopted for maintenance of the Proposed Scheme.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Operation

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Tributary of River Itchen south of Chapel Bank Cottage  (SWC-CFA16-002)  Map WR-01-025 (D5)	Moderate	Lower Radbourne South viaduct;  Embankment;  Drainage outfall;  Balancing pond.	Moderate adverse	Deterioration of water quality due to:  Deposition of soils, sediment and other construction materials, and spillage of fuels and other hazardous liquids;  The mobilisation of contaminants following disturbance of contaminated ground or groundwater.  Uncontrolled site run-off.	Adoption of Environment Agency PPGs – particularly PPG5 for in-channel works.  Mitigation measures outlined in draft CoCP.  Water management implemented during earthworks operation.  Temporary site drainage designed to retain surface run-off within site boundary.  Grey water systems used at construction site compounds.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Temporary)

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		Drainage outfall (from railway)	Moderate adverse	Impact on flows in the receiving watercourse.  Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.	Drainage has been designed to reduce the rate and volume of run-off from the proposed railway and to provide temporary storage for potential spillages.  Balancing pond before outfall to watercourse to restrict run-off rates and reduce the effect on water quality by reducing potential contaminants through filtration, vegetative absorption or settlement.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant))	Construction (Permanent)
		All elements (maintenance)	Moderate adverse	Deterioration of water quality due to contamination from de-icing substances used during cold weather and herbicides for managing vegetation on the tracks.	Best practice pollution control guidance will be adopted for maintenance of the Proposed Scheme.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Operation

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Tributary of River Itchen crossing at Chapel Bank Cottage  (SWC-CFA16-003)  Map WR-01-025 (C5)	Moderate	Lower Radbourne North viaduct;  Cutting;  Drainage outfalls;  Balancing ponds.	Moderate adverse	Deterioration of water quality due to:  Deposition of soils, sediment and other construction materials, and spillage of fuels and other hazardous liquids;  The mobilisation of contaminants following disturbance of contaminated ground or groundwater.  Uncontrolled site run-off.	Adoption of Environment Agency PPGs – particularly PPG5 for in-channel works.  Mitigation measures outlined in draft CoCP.  Water management implemented during earthworks operation.  Temporary site drainage designed to retain surface run-off within site boundary.  Grey water systems used at construction site compounds.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Temporary)

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		Drainage outfalls (from railway)	Moderate adverse	Impact on flows in the receiving watercourse.  Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.	Drainage has been designed to reduce the rate and volume of run-off from the proposed railway and to provide temporary storage for potential spillages.  Balancing pond before outfall to watercourse to restrict run-off rates and reduce the effect on water quality by reducing potential contaminants through filtration, vegetative absorption or settlement.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Permanent)
		All elements (maintenance)	Moderate adverse	Deterioration of water quality due to contamination from de-icing substances used during cold weather and herbicides for managing vegetation on the tracks.	Best practice pollution control guidance will be adopted for maintenance of the Proposed Scheme.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Operation

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Tributary of River Itchen at Ladbroke Fox Covert  (SWC-CFA16-004)  Map WR-01-025 (B4)	Moderate	Ladbroke culvert;  Realignment of Windmill Lane, including overbridge;  Cutting.	Moderate adverse	Deterioration of water quality due to:  Deposition of soils, sediment and other construction materials, and spillage of fuels and other hazardous liquids;  The mobilisation of contaminants following disturbance of contaminated ground or groundwater.  Uncontrolled site run-off.  In-channel construction work has the potential to have a moderate impact on the existing water environment, flows and the ecology supported through the disturbance of silt or the direct contamination by polluting materials.	Adoption of Environment Agency PPGs – particularly PPG5 for in-channel works.  Mitigation measures outlined in draft CoCP.  Water management implemented during earthworks operation.  Temporary site drainage designed to retain surface run-off within site boundary.  Grey water systems used at construction site compounds.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Temporary)



Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		Ladbroke culvert	Moderate adverse	Culvert may impact on the existing water environment, potentially changing flow characteristics and the ecology supported.	Improvements along watercourse either side of culvert, to mitigate loss of open length.	Minor to minor beneficial  Slight to slight beneficial  (not significant)	None required	Minor to minor beneficial  Slight to slight beneficial  (not significant)	Construction (Permanent)
		Drainage outfall (from realignment of Windmill Lane. Drainage assumed to join tributary of River Itchen at Ladbroke Fox Covert).	Moderate adverse	Impact on flows in the receiving watercourse.  Deterioration of water quality due to contamination of surface water from both routine discharges from the road and associated infrastructure or from accidental spillages.	Drainage has been designed to reduce the rate and volume of run-off from the road and to provide temporary storage for potential spillages.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Permanent)

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
Tributary of River Itchen at Starbold Farm, 110m west of route (watercourse does not intersect route)  Map WR-01-026 (D6)	Moderate	Realignment of A423 Banbury Road including overbridge;  Realignment of B4451 Kinton Road including overbridge;  Balancing ponds; and  Drainage outfalls.	Moderate adverse	Deterioration of water quality due to:  Deposition of soils, sediment and other construction materials, and spillage of fuels and other hazardous liquids;  The mobilisation of contaminants following disturbance of contaminated ground or groundwater; and  Uncontrolled site run-off.	Adoption of Environment Agency PPGs – particularly PPG5 for in-channel works.  Mitigation measures outlined in draft CoCP.  Water management implemented during earthworks operation.  Temporary site drainage designed to retain surface run-off within site boundary.  Grey water systems used at construction site compounds.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Temporary)

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		Drainage outfall (from realignment of A423 Banbury Road and B4451 Kineton Road. Drainage assumed to join tributary of River Itchen at Starbold Farm).	Moderate adverse	<p>Impact on flows in the receiving watercourse.</p> <p>Deterioration of water quality due to contamination of surface water from both routine discharges from the road and associated infrastructure or from accidental spillages.</p> <p>Initial water quality tests (HAWRAT from the DMRB<sup>17</sup>) have shown that mitigation is required to offset potential impacts to the water environment (particularly to address copper concentrations and the dispersal of sediments).</p>	<p>Drainage has been designed to reduce the rate and volume of run-off from the road and to provide temporary storage for potential spillages.</p> <p>Balancing ponds before outfall to watercourse to restrict run-off rates and reduce the effect on water quality by reducing potential contaminants through filtration, vegetative absorption or settlement.</p>	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	Construction (Permanent)

<sup>17</sup> DMRB, 2009. Volume 11 Section 3 Part 10 HD45/09 Road Drainage and the Water Environment.

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		Drainage outfall (from railway)	Moderate adverse	Impact on flows in the receiving watercourse.  Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.	Drainage has been designed to reduce the rate and volume of run-off from the proposed railway and to provide temporary storage for potential spillages.  Balancing ponds before outfall to watercourse to restrict run-off rates and reduce the effect on water quality by reducing potential contaminants through filtration, vegetative absorption or settlement.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Permanent)
		All elements (maintenance)	Moderate adverse	Deterioration of water quality due to contamination from de-icing substances used during cold weather and herbicides for managing vegetation on the tracks.	Best practice pollution control guidance will be adopted for maintenance of the Proposed Scheme.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Operation

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
River Itchen crossing at Thorpe Bridge  (SWC-CFA16-005)  Map WR-01-026 (B6)	Moderate	River Itchen viaduct ;  Reinstatement of A425 Leamington Road;  Drainage outfalls; and  Balancing ponds.	Moderate adverse	Deterioration of water quality due to:  Deposition of soils, sediment and other construction materials, and spillage of fuels and other hazardous liquids;  The mobilisation of contaminants following disturbance of contaminated ground or groundwater;  Uncontrolled site run-off.	Adoption of Environment Agency PPGs – particularly PPG5 for in-channel works.  Mitigation measures outlined in draft CoCP.  Water management implemented during earthworks operation.  Temporary site drainage designed to retain surface run-off within site boundary.  Grey water systems used at construction site compounds.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Temporary)

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		Drainage outfall (from reinstatement of A425 Leamington Road. Drainage assumed to join River Itchen at Thorpe Bridge).	Moderate adverse	Impact on flows in the receiving watercourse. Deterioration of water quality due to contamination of surface water from both routine discharges from the road and associated infrastructure or from accidental spillages.  HAWRAT result show that mitigation would not be required to offset the potential impacts the water environment.	Drainage has been designed to reduce the rate and volume of run-off from the road and to provide temporary storage for potential spillages.	Negligible  Neutral  (not significant)	None	Negligible  Neutral  (not significant)	Construction (Permanent)
		Drainage outfalls (from railway)	Moderate adverse	Impact on flows in the receiving watercourse. Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.	Drainage has been designed to reduce the rate and volume of run-off from the proposed railway and to provide temporary storage for potential spillages.  Balancing pond before outfall to watercourse to restrict run-off rates and reduce the effect on water quality by reducing potential contaminants through filtration, vegetative absorption or settlement.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Permanent)

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		All elements (maintenance)	Moderate adverse	Deterioration of water quality due to contamination from de-icing substances used during cold weather and herbicides for managing vegetation on the tracks.	Best practice pollution control guidance will be adopted for maintenance of the Proposed Scheme.	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	Operation
Tributary of River Leam at Longhole Bridge  (SWC-CFA16-006)  Map WR-01-027 (E5)	Moderate	Watercourse to be diverted around viaduct abutment;  Longhole viaduct;  Embankment;  Drainage outfall;  Balancing pond.	Moderate adverse	Deterioration of water quality due to:  Deposition of soils, sediment and other construction materials, and spillage of fuels and other hazardous liquids;  The mobilisation of contaminants following disturbance of contaminated ground or groundwater;  Uncontrolled site run-off.	Adoption of Environment Agency PPGs – particularly PPG5 for in-channel works.  Mitigation measures outlined in draft CoCP.  Water management implemented during earthworks operation.  Temporary site drainage designed to retain surface run-off within site boundary.  Grey water systems used at construction site compounds.	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	Construction (Temporary)

Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		Drainage outfall (from railway)	Moderate required	Impact on flows in the receiving watercourse. Deterioration of water quality due to contamination of surface water from both routine discharges from the proposed railway and associated infrastructure or from accidental spillages.	Drainage has been designed to reduce the rate and volume of run-off from the proposed railway and to provide temporary storage for potential spillages.  Balancing pond before outfall to watercourse to restrict run-off rates and reduce the effect on water quality by reducing potential contaminants through filtration, vegetative absorption or settlement.	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Permanent)
		Watercourse to be diverted around viaduct abutment.	Moderate adverse	Deterioration or loss of the existing water environment, flows and the ecology supported.	Opportunities will be taken to retain and if possible enhance the overall quality of the watercourses, for example by including meanders and enhanced banks.	Minor to minor beneficial  Slight to slight beneficial  (not significant)	None required	Minor to minor beneficial  Slight to slight beneficial  (not significant)	Construction (Permanent)



Surface water feature/ receptor <sup>15</sup>	Value of surface water feature <sup>16</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to water resource	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation measures	Residual effect	Duration of effect
		All elements (maintenance)	Moderate adverse	Deterioration of water quality due to contamination from de-icing substances used during cold weather and herbicides for managing vegetation on the tracks.	Best practice pollution control guidance will be adopted for maintenance of the Proposed Scheme.	Negligible  Neutral  (not significant)		Negligible  Neutral  (not significant)	Operation

## 4.2 Groundwater

4.2.1 Following the methodology outlined in the SMR addendum (see Volume 5: Appendix CT-001-000/2), the hydraulic conductivity values obtained from available literature values, were used in conjunction with professional judgment to estimate the maximum extent of the zone of influence that is likely to be produced when dewatering of a cutting occurs. The hydraulic conductivity values used are generally in the high range of literature values to provide a realistic factor of safety to the estimated zone of influence. Based on this worst case assumption, the zone of influence is likely to be overestimated, however, for the purpose of this preliminary assessment; this approach is considered to be acceptable.

4.2.2 Aquifer properties used for estimating the zone of influence can be found in Table 9.

Table 9: Aquifer properties

Lithology	Maximum hydraulic conductivity value used in calculations	References
Mudstone and dolomitic siltstone of the Charmouth Mudstone Formation	0.28m/d	Hiscock (2005) <sup>18</sup> , BGS Minor Aquifers Properties Manual <sup>19</sup>
Rugby Limestone Member	0.28m/d	Hiscock (2005), BGS Minor Aquifers Properties Manual
Saltford Shale Member	0.28m/d	Hiscock (2005), BGS Minor Aquifers Properties Manual
Penarth Group	0.43m/d	EDF Energy (2010) <sup>20</sup> , Minor BGS Aquifers Properties Manual
Mercia Mudstone Group-Mudstone and Dolomitic siltstone	0.1m/d	Tellam and Lloyd <sup>21</sup>
Arden Sandstone Formation	0.518m/d	Domenico and Schwartz (1990) <sup>22</sup>
Alluvium	86m/d	Hiscock (2005)

4.2.3 The zone of influence for the dewatering of the cuttings along the route was calculated at frequent intervals as topography, geology and track level change, using the methodology outlined in the SMR addendum (see Volume 5: Appendix CT-001-000/2) and the properties in Table 9, Table 10, summarises the estimated zone of influence within the study area for each of the cuttings. In each case, the maximum zone of influence value reported has not been applied to the whole extent of the cutting; it is purely illustrative of the worst-case conditions at its deepest section.

<sup>18</sup> Hiscock, K.M. (2005), Hydrogeology: Principles and Practice, Blackwell Science Ltd, Oxford.

<sup>19</sup> British Geological Survey (1997), The Physical Properties of Minor Aquifers in England and Wales. P84.

<sup>20</sup> EDF Energy (2010), Hinkley Point C Pre-application consultation stage 2. Environmental Appraisal. Vol2. Chapter 14: Groundwater and Geology.

<sup>21</sup> Tellam J.H. and Lloyd J.W. (1981), A review of the hydrogeology of British onshore non-carbonate mudrocks. Quarterly Journal of Engineering Geology and Hydrogeology 1981, v.14; p347-355.

<sup>22</sup> Domenico, P.A. and F.W. Schwartz (1990), Physical and Chemical Hydrogeology, John Wiley & Sons, New York.

Table 10: Maximum extent of zone of influence in CFA16

Cutting	Geology	Maximum drawdown within cutting	Maximum zone of influence estimated from maximum drawdown	Comments
Boddington cutting	Charmouth Mudstone Formation	16m	87m	
Ladbroke Grove cutting	Charmouth Mudstone Formation	8m	43m	
Ladbroke cutting	Charmouth Mudstone Formation	29m	157m	
Southam cutting	Rugby Limestone Member	11m	60m	
	Saltford Shale Member	9m	47m	
Leamington Road cutting	Penarth Group	4m	27m	
Long Itchington Wood green tunnel	Penarth Group	16m	107m	
Long Itchington Wood tunnel	No zone of influence generated as bored tunnel; dewatering is not required.			
Ufton Wood cutting	Mercia Mudstone Group overlain by Arden Sandstone Formation	10m	44m	Bulk hydraulic conductivity used.
	Mercia Mudstone Group	7m	23m	

4.2.4 The following table summarises the potential impacts to groundwater, abstractions, water dependent habitats and groundwater/ surface water interactions.

Table 11: Summary of potential impacts to groundwater, abstractions, water dependent habitats and groundwater/ surface water interactions

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
<b>Aquifers</b>								
Secondary A Superficial aquifer: Alluvium (moderate)	Ladbroke cutting; Southam cutting; Leamington cutting; Long Itchington Wood green tunnel; Ufton Wood cutting; River Itchen viaduct; Ladbroke culvert; Construction traffic route; Worksites and construction compounds.	Moderate adverse	Dewatering may reduce groundwater levels within the aquifer.  Potential for contaminants to enter groundwater during construction (e.g. suspended solids, leaks from machinery).  Reduced infiltration could locally reduce groundwater levels; however, this is likely to be minimal and temporary.	Sustainable drainage systems (SuDS) such as infiltration trenches will be located where gravity transfer is feasible to facilitate groundwater recharge.  Contamination control measures as required by the draft CoCP Section 16.	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	Construction (Permanent)

<sup>23</sup> For examples of receptor value see Table 43 in the SMR addendum Volume 5 Appendix CT-001-000/2.

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Unproductive Bedrock: Charmouth Formation (low)	Boddington cutting; Ladbroke Grove cutting; Ladbroke cutting; Embankments; Viaducts; Worksites and construction compounds.	Negligible	Dewatering may reduce the groundwater levels within the aquifer.  Potential for contaminants to enter groundwater during construction (e.g. suspended solids, leaks from machinery).	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Secondary A, Secondary B and Secondary undifferentiated bedrock aquifers: Rugby Limestone Member, Saltford Shale member, Langport Member, Pernarth Group, Mercia Mudstone Group  (moderate)	Southam cutting; Leamington cutting; Long Itchington Wood green tunnel; Long Itchington Wood tunnel; Ufton Wood cutting; Foundations for viaducts and bridges; Worksites and construction compounds; Road realignments and hardstanding; Stockpiles; Embankments; Construction traffic route.	Moderate adverse	Dewatering may reduce the groundwater levels within the aquifer.  Potential for contaminants to enter groundwater during construction (e.g. suspended solids, leaks from machinery).  Foundations have potential to alter groundwater flow regime, however any change is likely to be localised and minimal.  Reduced infiltration could locally reduce groundwater levels; however, this is likely to be minimal and temporary.	SuDS such as infiltration trenches will be located where gravity transfer is feasible to facilitate groundwater recharge.  Contamination control measures as required by the draft CoCP Section 16.	Negligible Neutral (not significant)	None required	Negligible Neutral (not significant)	Construction (Permanent)

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
<b>Abstractions</b>								
Groundwater abstraction Spring at Stoneton Moat Farm (moderate)  CFA16-GWUA1  Map WR-02-016 (H6) Stoneton, 2.8km south-east of Lower Radbourne South viaduct	Boddington cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Licensed groundwater abstraction at Oaktree House, Bascote Heath (moderate)  MD/054/0012/002  Map WR-02-016 (C6) Bascote Heath, 1km south-west of Bascote	Long Itchington Wood tunnel	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Borehole at Wood Farm (moderate)  CFA16-GWUA2  Map WR-02-016 (B6), 1km north-east of Ufton	Ufton Wood cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Borehole at Round Brill, near Ridgeway Lane and Snowford Lodge (moderate)  CFA16-GWUA <sub>3</sub>  Map WR-02-016 (A5), 2km east of Offchurch	Offchurch cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Borehole at Snowford House, near Ridgeway Lane (moderate)  CFA16-GWUA <sub>4</sub>  Map WR-02-016 (A5), 2km east of Offchurch	Offchurch cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
<b>Water dependent habitats</b>								
Oxford Canal, will be crossed by the route (moderate)  Map EC-01-041 (I6 and I7), will be crossed by Oxford Canal viaduct	Boddington cutting;  Oxford Canal South embankment;  Oxford Canal viaduct.	Negligible	Located within zone of influence.  The receptor is unlikely to be impacted by the route as it is an artificial feature and therefore likely to be isolated from the scheme.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None



Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
<p>Lower Radbourne Church Pools, will be crossed by the route (moderate)</p> <p>Map EC-01-041 (E4 to E7) will be crossed by Lower Radbourne South viaduct at EC-01-041 (E6)</p>	<p>Upper Radbourne embankment;</p> <p>Lower Radbourne embankment;</p> <p>Lower Radbourne North viaduct.</p>	Minor adverse	<p>Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.</p> <p>Potential for contaminants to enter groundwater during construction (e.g. suspended solids, leaks from machinery).</p> <p>Any lowering of groundwater levels for the construction of the 5m deep viaduct foundations should be minimal and temporary.</p> <p>Reduced infiltration could locally reduce groundwater levels; however, this is likely to be minimal and temporary.</p>	None required	<p>Minor</p> <p>Slight</p> <p>(not significant)</p>	None required	<p>Minor</p> <p>Slight</p> <p>(not significant)</p>	Construction (Permanent)
<p>Southam Meadow South local wildlife site 450m north-east of the route (high)</p> <p>Map EC-01-043 (I3 and I4)</p> <p>1.5km south-east of River Itchen viaduct</p>	<p>Ladbroke cutting;</p> <p>Southam embankment.</p>	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
<p>River Itchen, Breakneck Fields, will be crossed by the route (moderate)</p> <p>Map EC-01-043 (E7), will be crossed by River Itchen viaduct</p>	<p>River Itchen viaduct;</p> <p>Leamington Road cutting;</p> <p>Southam cutting;</p> <p>Worksite for River Itchen viaducts with medium construction compound.</p>	Moderate adverse	<p>River is within the zone of influence. The potential reduction in groundwater levels may locally reduce the volume of water in the river. Potential for contaminants to enter groundwater during construction (e.g. suspended solids, leaks from machinery).</p> <p>Any lowering of groundwater levels for the construction of the 5m deep viaduct foundations should be minimal and temporary.</p> <p>Reduced infiltration could locally reduce groundwater levels; however, this is likely to be minimal and temporary.</p>	<p>SuDS such as infiltration trenches will be located at the northern end of Southam cutting and at Leamington cutting to facilitate groundwater recharge.</p> <p>Contamination control measures as required by the draft CoCP Section 16.</p>	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	Construction (Permanent)
<p>Unnamed ancient Woodland 850m north-east of the route (high)</p> <p>Map EC-01-043(C3) 1km north-east of River Itchen viaduct</p>	<p>Long Itchington Wood green tunnel;</p> <p>Long Itchington Wood tunnel.</p>	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None

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Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
<p>Thorpe Rough Ancient Woodland 350m north-east of the route (high)</p> <p>Map EC-01-043 (C3, C4 and C5)</p> <p>880m north-east of River Itchen viaduct</p>	<p>Long Itchington Wood green tunnel;</p> <p>Long Itchington Wood tunnel.</p>	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None
<p>Ufton Fields Nature Reserve, SSSI and LNR: 950m south-west of the route (high)</p> <p>Map EC-01-044a (I10 and J10); WR-03-027 (G7, G8, F7 and F8), 1.7km west of River Itchen viaduct</p>	Long Itchington Wood tunnel	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None
<p>Long Itchington Wood (Ufton Wood) SSSI and Ancient Woodland will be crossed by the route (high)</p> <p>Map EC-01-44a (H6) 870m south-east of Longhole viaduct</p>	<p>Long Itchington Wood tunnel;</p> <p>Long Itchington Wood North Portal.</p>	Negligible	<p>The receptor is outside of the zone of influence.</p> <p>The settlement created by the tunnel is unlikely to have a significant impact upon the SSSI.</p> <p>Not assessed to be groundwater dependent as located at elevated topography.</p>	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	Construction (Permanent)

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Print Wood Ancient Woodland and Local Wildlife Site 850m north-east of the route (high)  Map EC-01-44a (C3), 940m north-east of Longhole viaduct	Longhole viaduct;  Grand Union Canal embankment;  Offchurch cutting.	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	None
<b>Surface water / groundwater interaction</b>								
Issues 260m north-east of The Hall Farm, 720m south-west of the route (moderate)  Map WR-02-016 (I7), 1km south-east of Wormleighton	Boddington cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	None
Pond near Fox Covert and Sheep Pens, 60m south-west of the route (low)  Map EC-04-040b (G7), 1km east of Wormleighton	Boddington cutting	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Pond near Fox Covert and Sheep Pens, 25m north-east of the route (low)  Map EC-04-040b (G6), 1km east of Wormleighton	Boddington cutting	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Pond near Fox Covert and Sheep Pens, 50m south-west of the route (low)  Map EC-04-040b (G7), 1km east of Wormleighton	Boddington cutting	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				

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Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Spring at southern edge of Berryhill Plantation, 300m north-east of the route (moderate)  Map WR-02-016 (I6), 1.3km east of Wormleighton	Boddington cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Spring at north-east edge of Berryhill Plantation, 550m north-east of the route (moderate)  Map WR-02-016 (I6), 1.4km east of Wormleighton	Boddington cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Spring 70m north of Berryhill Plantation, 650m north-east of the route (moderate)  Map WR-02-016 (I5), 1.5km east of Wormleighton	Boddington cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Spring south-west of Berryhill Farm, 1.05km north-east of the route (moderate)  Map WR-02-016 (H5), 1.7km north-east of Wormleighton	Boddington cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Spring south-west of Berryhill Farm, 975m north-east of the route (moderate)  Map WR-02-016 (H5), 1.7km north-east of Wormleighton	Boddington cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Spring south-east of Newfield Pool, 500m north-east of the route (moderate)  Map WR-02-016 (H6), 1.2km north-east of Wormleighton	Boddington cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Issues near Stoneton Manor and moat, 800m north-east of the route (moderate)  Map WR-02-016 (H5), 1.5km north-east of Wormleighton	Boddington cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Pond near Wormleighton, 200m south-west of the route (low)  Map EC-04-04ob (D7), 500m north-east of Wormleighton	Boddington cutting	Major	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Issues south-east of Church Farm, 100m north-east of the route (moderate)  Map WR-02-016 (G6), 1.6km north of Wormleighton	Oxford Canal South embankment;  High voltage powerline across receptor;  Mitigation earthworks more than 20m away.	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.  Negligible impact anticipated as utilities and earthworks near to the issues are likely to have minimal impact upon groundwater in the vicinity.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None

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Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Stream 650m south-east of Lower Radbourne Farm will be crossed by the route (moderate)  Map WR-02-016 (G6), crossed by Lower Radbourne South viaduct	Lower Radbourne south viaduct;  Oxford Canal South embankment;  Balancing pond discharging to stream;  Worksite with construction compound and construction traffic route with bridge crossing stream.	Negligible	Located within zone of influence.  Stream assessed unlikely to be groundwater dependent as located on Unproductive strata.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	None
Pond 500m south-east of Lower Radbourne Farm, 90m west of the route (low)  Map EC-04-041 (E7), 150m south-west of Lower Radbourne North viaduct	Upper Radbourne embankment;  Mitigation earthworks near to pond.	Negligible	Located within zone of influence.  Pond assessed unlikely to be groundwater dependent as located on Unproductive strata.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	None
Issues north-east of Lower Radbourne Farm, 700m south-west of the route (moderate)  Map WR-02-016 (F6), 750m west of Lower Radbourne North viaduct	Ladbroke Grove cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	None

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Pond 770m south-west of Upper Radbourne Farm, 50m north-east of the route (low)  Map EC-04-041 (C6), 650m north of Lower Radbourne North viaduct	Ladbroke Grove cutting;  Mitigation earthworks adjacent to pond.	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Pond 620m north of Lower Radbourne Farm, 200m south-west of the route (low)  Map EC-04-041 (C7), 800m north-west of Lower Radbourne North viaduct	Ladbroke Grove cutting;  Diverted road adjacent to pond.	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Pond 750m north of Lower Radbourne Farm, 300m south-west of the route (low)  Map EC-04-041 (B7), 960m north-west of Lower Radbourne North viaduct	Ladbroke Grove cutting;  Diverted road adjacent to pond.	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Pond near Ladbroke Grove Farm, 110m north-east of the route (low)  Map EC-04-042 (I6), 1.35km north-west of Lower Radbourne North viaduct	Ladbroke Grove cutting	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				



Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
<p>Tributary of River Itchen north of Ladbroke Fox Covert, will be crossed by the route (moderate)</p> <p>Map WR-02-016 (F5), crosses scheme 1km east of Ladbroke</p>	<p>Ladbroke Grove embankment;</p> <p>Ladbroke cutting;</p> <p>Ladbroke culvert;</p> <p>Construction traffic route across stream;</p> <p>Proposed mitigation landscaping adjacent.</p>	Moderate adverse	<p>The stream is within the zone of influence created by the cuttings and therefore could locally decrease the total volume of water supplying the river and potentially lower water levels and flow within the water course through leaching to the underlying aquifers.</p> <p>Potential for contaminants to enter groundwater during construction (e.g. suspended solids, leaks from machinery).</p> <p>Reduced infiltration could locally reduce groundwater levels; however, this is likely to be minimal and temporary.</p>	<p>SuDS such as infiltration trenches will be located at the northern end of Ladbroke embankment and the southern end of Ladbroke cutting, near the watercourse to facilitate groundwater recharge, balancing ponds.</p> <p>Contamination control measures as required by the draft CoCP Section 16.</p>	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	Construction (Permanent)
<p>Issues 400m north of Ladbroke Grove Farm, 600m north-east of the route (moderate)</p> <p>Map WR-02-016 (F5), 1.6km east of Ladbroke</p>	Ladbroke cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None required	<p>Negligible</p> <p>Neutral</p> <p>(not significant)</p>	None

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Pond adjacent to Windmill Lane and track from Ladbroke Hill Farm, 25m west of the route (low)  Map EC-04-042 (G6), 750m east of Ladbroke	Ladbroke cutting;  Construction traffic route across pond;  Realignment of Windmill Lane near pond;  Worksite.	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Issues near Ladbroke Hall and Church Road in Ladbroke, 1.1km south-west of the route (moderate)  Map WR-02-016 (E6), in Ladbroke	Ladbroke cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	None
Pond near Windmill Lane, 200m southwest of the route (low)  Identifier: 030-AA-122002  Map EC-04-042 (F7), 325m north-west of Windmill Lane Green Overbridge	Ladbroke cutting;  Construction traffic route across pond;  Realignment of Windmill Lane near pond;  Worksite.	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Pond 350m north of Windmill Hill Spinney, 60m north-east of the route (low)  Identifier:030-AA-123002  Map EC-04-042 (E6), 700m northeast of Ladbroke	Ladbroke cutting	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				

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Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Tributary of River Itchen crosses A423 near Starbold Farm, 190m south-west of the route (moderate)  Map WR-02-016 (E6), 580m north of Ladbroke	Ladbroke cutting;  Realignment of A423 Banbury Road crosses the stream;  Worksite and material transfer stockpile area.	Negligible	Located within zone of influence.  Stream assessed unlikely to be groundwater dependent as located on Unproductive strata.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	None
Pond 500m southeast of Starbold Farm, 10m south-west of the route (low)  Identifier 030-AA-123001  Map EC-04-042 (D6), 750m north of Ladbroke	Ladbroke cutting	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Pond near Harp Farm, 128m north-east of the route (low)  Identifier: 030-AA-124002  Map EC-04-042 (C6), 800m north of Ladbroke	Ladbroke cutting	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Two Ponds (Harp Ponds), near Harp Farm, 10m south-west of the route (moderate)  Map EC-04-042 (C6), 800m north of Ladbroke	Ladbroke cutting	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Tributary of River Itchen, 340m north-west of Starbold Farm, 100m south-west of the route (moderate)  Map WR-02-016 (D6), 1.4km north of Ladbroke	Southam embankment;  Construction traffic route adjacent to scheme and near to receptor;  Electricity pylons adjacent to watercourse.	Minor adverse	Reduced infiltration could locally reduce groundwater levels; however, this is likely to be minimal and temporary.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	Construction (Permanent)
Pond 72m north-east of the route (low)  Map EC-04-043 (H6), 400m south-west of Southam	Southam embankment	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Pond at Southam Rugby Football Club, 265m south-west of the route (low)  Map EC-04-043 (H7), 300m south-west of B4451 Kington Road overbridge	Southam cutting;  Realignment of B4451 Kington Road.	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Pond at Southern edge of Southam Industrial Estate, adjacent to B4451 Kington Road, 50m north-east of the route (low)  Map EC-04-043 (H6), Near B4451 adjacent to B4451 Kington Road overbridge	Southam cutting;  Construction compound adjacent to pond.	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				

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Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Issues 300m north-west of Fields Farm, 750m south-west of the route (moderate)  Map WR-02-016 (D6), 1.8km north-west of Ladbroke	Southam cutting; Leamington Road cutting.	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Issues at Stapenhall Farm. 1.1km south-west of the route (moderate)  Map WR-02-016 (D7), 950m north of Deppers Bridge	Southam cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Issues 400m north of Stapenhall Farm, 1.1km south-west of the route (moderate)  Map WR-02-016 (D7) 1.3km north of Deppers Bridge	Southam cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Sinks 600m north of Stapenhall Farm, 800m south-west of the route (moderate)  Map WR-02-016 (D7) 815m south-west of River Itchen viaduct	Southam cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Sinks 300m south of Lower Farm, 450m south-west of the route (moderate)  Map WR-02-016 (D6) 235m south-west of River Itchen Viaduct	Southam cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Issues east of Ufton Farm Landfill, 720m south-west of the route (moderate)  Map WR-02-016 (C6) 1.6km north of Deppers Bridge	Long Itchington Wood green tunnel	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Spring 100m south of Stoneythorpe Hall, 500m north-east of the route (moderate)  Map WR-02-016 (C6) 500m north-east of River Itchen viaduct	Long Itchington Wood green tunnel; Leamington cutting.	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Sinks at western edge of Ufton Farm Landfill, 1.2km south-west of the route (moderate)  Map WR-02-016 (C7), 1.4km west of River Itchen viaduct	Long Itchington Wood green tunnel	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None

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Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Issues 180m north of Monkey Barn Farm, 800m south-west of the route (moderate)  Map WR-02-016 (C7), 1.2km west of River Itchen Viaduct	Long Itchington Wood tunnel	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Issues along Ufton Hill Farm track, west of landfill, 1.2km south-west of the route (moderate)  Map WR-02-016 (C7), 1.5km west of River Itchen Viaduct	Long Itchington Wood tunnel	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Pond 20m north-east of the route (low)  Identifier:030-AA-127001  Map EC-04-043 (C6 and C7), 400m south of Bascote Heath	Long Itchington Wood tunnel;  Within settlement contours of the proposed tunnel.	Negligible	The tunnel does not create a zone of influence as dewatering is not required during construction.	None Required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Issues 130m south of Heath Farm, 250m north-east of the route (moderate)  Map WR-02-016 (C6), 300m south of Bascote Heath	Long Itchington tunnel;  Proposed planting at receptor as ecological mitigation.	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None

Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Sinks 130m south-east of Long Itchington Wood, near War Memorial, 20m south-west of the route (moderate)  Map WR-02-016 (C6) 1.1km north-east of River Itchen viaduct	Long Itchington Wood tunnel	Negligible	The tunnel does not create a zone of influence as dewatering is not required during construction, therefore no impact.	None Required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Issues at western edge of Long Itchington Wood SSSI, 800m south-west of the route (moderate)  Map WR-02-016 (C7) 360m north-east of Ufton	Long Itchington Wood tunnel	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Issues at Welsh Road, 350m northwest of Crossroads Cottage, 625m north-east of the route (moderate)  Map WR-02-016 (C6), 440m north of Bascote Heath	Long Itchington Wood tunnel	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible Neutral  (not significant)	None required	Negligible Neutral  (not significant)	None
Pond near Grand Union Canal, 160m north-east of the route (low)  Map EC-02-44a (E6) 200m south-east of Longhole viaduct	Grand Union Canal embankment	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				



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Groundwater receptor (and value) <sup>23</sup>	Design element	Magnitude of impact (no mitigation)	Potential impact to groundwater	Avoidance and mitigation measures	Magnitude of remaining impact and effect	Other mitigation	Residual effect	Duration of effect
Drain will be crossed by the route (moderate)  Map WR-02-016 (B6) near Longhole viaduct	Ufton Wood cutting; and  Longhole viaduct north of receptor.	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	None
Pond near Grand Union Canal, 60m south-west of the route (low)  Map EC-04-044a (E7) 60m west of Longhole viaduct	Grand Union Canal embankment	Major adverse	Pond assumed to be removed during construction of the Proposed Scheme.	Refer to ecology Volume 2, CFA Report 16, Section 7.				
Issues, 170m south-west of the route (moderate)  Map WR-02-016 (B6) near Longhole viaduct	Ufton Wood cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	None
Issues near Print Farm, 670m north-east of the route (moderate)  Map WR-02-016 (B5) 640m north-east of Longhole viaduct	Ufton Wood cutting	Negligible	Not located within zone of influence therefore unlikely to receive adverse impacts from changes to groundwater.	None required	Negligible  Neutral  (not significant)	None required	Negligible  Neutral  (not significant)	None

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